REMARKS

The Final Office Action mailed December 29, 2003, has been received and reviewed. Claims 1 through 18, 33 through 37, 39, 40, and 42 through 61 are currently pending in the application. Claims 47 through 49, 51 through 55, and 61 have been withdrawn from consideration as being drawn to non-elected invention(s). Claims 1 through 18, 33 through 37, 39, 40, 42 through 46, 50, and 56 through 60 stand rejected.

Applicants have amended claims 1 and 8, and respectfully request reconsideration of the application as amended herein.

35 U.S.C. § 103(a) Obviousness Rejections

Obviousness Rejection Based on U.S. Patent No. 3,051,639 to Anderson in View of U.S. Patent No. 3,954,954 to Davis et al.

Claims 1 through 3, 5 through 10, 12 through 16, 18, 33, 34, 36, 44 through 46, 50, and 58 through 60 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anderson (U.S. Patent No. 3,051,639) in view of Davis et al. (U.S. Patent No. 3,954,954). Applicants respectfully traverse this rejection, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for a Section 103(a) rejection:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, **the prior art reference (or references when combined) must teach or suggest all the claim limitations.** The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (Emphasis added).

The 35 U.S.C. § 103(a) obviousness rejections are improper because the references fail to teach or suggest all of the limitations of the presently claimed invention

and because there is a lack of motivation to combine the references in the manner suggested by the Examiner.

Claims 1 through 3 and 5 through 7

Independent claim 1, as amended herein, is directed to a method of converting one or more reactants to a desired end product. The method comprises: introducing a reactant stream into an injection line at one end of an axial reactor; *independently introducing a stream of heating gas into the injection line for mixture with the reactant stream; thoroughly mixing the reactant stream with the heating gas within the injection line to produce a thoroughly mixed reactant stream prior to entry thereof into a reactor chamber*; passing the thoroughly mixed reactant stream axially from the injection line to the reactor chamber; *maintaining a volume defined by the reactor chamber at a substantially uniform temperature as the thoroughly mixed reactant stream passes therethrough;* and producing a desired end product stream at a location adjacent an outlet end of the axial reactor. Applicant submits that Anderson fails to teach all of the limitations of claim 1 of the presently claimed invention.

The Examiner cites Anderson as disclosing an arc torch chemical reactor for the production of acetylene from methane wherein a reactant stream is passed into the reactor and mixed with a heating gas. The Examiner further cites Anderson as teaching that the "temperature is maintained at 5000K, which is a uniform temperature over the length of the reaction zone" and that the reactor includes an insulating layer comprising carbon and zirconia. (Final Action, page 3).

The Examiner cites Davis as teaching a process of carrying out high temperature, chemical reactions, including reductions for producing elemental metal powders using a plasma generator. More specifically, the Examiner cites Davis as teaching that the stabilizer gas which is used to generate the plasma may also comprise a reactant gas; that the feed gas and the reactant gas are carried by the plasma into an axially extending reaction member; and that the plasma reactor may be maintained between a temperature

range of 1800°K and 5000°K.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the teachings of Anderson based on the teachings of Davis by thoroughly mixing a reactant stream with a heating gas within an injection line stating that one of ordinary skill in the art "would have been motivated to combine the cited references, because Anderson and Davis et al., both teach processes for converting one or more reactants to a desired end product." (Final Action, page 4). Applicants respectfully traverse this rejection.

Anderson teaches three significantly different embodiments of torch reactors. In the first embodiment, as shown in FIG. 1, an arc gas flows around an annular passage formed about the cathode, through a nozzle, and into the reaction chamber. A fluid hydrocarbon is introduced into the *reaction chamber* for mixture and reaction with the heated arc gas. The resulting mixture then passes to a quenching chamber where the mixture is sprayed with a quenching fluid for the cooling thereof. The cooled reaction gases may then be passed to a collector and separated into individual components. (See, col. 3, lines 15-40).

In the second embodiment disclosed by Anderson, as shown in FIG. 2, the arc gas, along with an inert shielding gas used in conjunction with the arc torch, is passed through a passage and into a reaction chamber. The reaction chamber contains a volume of liquid hydrocarbons. The velocity of the heated gases prevents the liquid from flowing back through the passage. The mixing of the gases with the liquid hydrocarbons takes place in the *reaction chamber*. Furthermore, Anderson states that the "cooler liquid hydrocarbon in the upper portion of the [reaction] chamber 60 quenches the hot products of the pyrolysis reaction." (Col. 4, lines 21-22). Such clearly indicates the existence of temperature gradient or a "nonuniform" temperature within the reactor chamber.

In the third embodiment disclosed by Anderson, as shown in FIG. 3, a fluid hydrocarbon is injected into a hot flowing arc gas in a cylindrical passage. The gases are mixed as they pass through a "confining disc" right before entering a quenching zone

which is filled with a quenching liquid (i.e., water). (See, e.g. col. 4. lines 61-70).

Applicants note that Anderson fails to teach, with respect to any of the embodiments disclosed therein, *thoroughly mixing the reactant stream with the heating gas within the injection line* (wherein the reactant stream and the heating gas are independently introduced into the injection line) to produce a thoroughly mixed reactant stream *prior to entry thereof into a reactor chamber.*

Additionally, while the Examiner cites Anderson as teaching an arc torch reactor which maintain a substantially uniform temperature at 5000° K over the length of a reaction zone, Applicants note that Anderson actually states that the "*effective* temperature of the arc *effluent* in the examples [is] about 5000° K." (Col. 5, lines 40-42). Applicant notes that Anderson sets forth the temperature of the *effluent* (e.g., outflowing gas), not of the volume defined by the reaction chamber. Additionally, the use of the adjective *effective* as a modifier for the term "temperature" clearly indicates variation in the effluent temperature. As such, Applicants submit that Anderson fails to teach or suggest that a volume defined by the reactor chamber is maintained at a substantially uniform temperature.

With respect to Davis, Applicants note that Davis teaches a plasma generator having a feed inlet (6) for the introduction of feed material and a reactant gas inlet (8) for the introduction of a reactant gas. The Examiner points to col. 5, lines 23-27 and 31-38 as teaching the thorough mixing of a heating gas with a reactant gas in an injection line. However, Applicants note that such passages fail to teach or suggest thorough mixing of such components within an injection line. Rather, these passages simply teach generally that a reactant gas may be introduced at various locations within the apparatus. More specifically, Davis states the following:

> Where a stabilizer gas is used to generate the plasma, the carrier gas for the feed material may also comprise a reactant gas such as hydrogen, where the refractory metal compound is to be reduced, and/or a reactant gas may be

introduced adjacent the point of feed material introduction by means of reactant gas inlet 8. (Col. 5, lines 23-28).

While such a statement indicates that a reactant gas may be introduced at one or more of a number of locations within the described apparatus, it fails to teach or suggest that a reactant stream and a heating gas be independently introduced into an injection line and that *the reactant stream be thoroughly mixed with the heating gas within the injection line to produce a thoroughly mixed reactant stream prior to entry thereof into a reactor chamber*. Applicants further submit that Davis fails to teach or suggest that a volume defined by the reactor chamber is maintained at a substantially uniform temperature.

Applicants further note that the Examiner has failed to provide any motivation to combine Anderson and Davis. Rather, the Examiner has simply provided a conclusory statement to the effect that one of ordinary skill in the art would be motivated to combined the references in a specific manner because both Anderson and Davis "teach processes for converting one or more reactants to a desired end product." (Final Action, page 4). Applicants submit that such a statement regarding motivation lacks adequate specificity and reasoning to establish a prima facie case of obviousness.

As such, Applicants submit that claim 1 is allowable over Anderson and Davis. Applicants further submit that claims 2, 3 and 5 through 7 are also allowable as being dependent from an allowable base claim as well as for the additional patentable subject matter introduced thereby.

With respect to claim 3, Applicants submit that Anderson and Davis fail to teach or suggest that the reactant stream comprises methane or carbon monoxide and the desired end product comprises hydrogen. While the Examiner cites Anderson as teaching such subject matter, Applicants note that Anderson teaches the use of hydrogen as a torch gas, not as a desired end product. More specifically, Anderson states the following:

> In the *production of acetylene* from hydrocarbons, it has been found desirable to add dissociable gases, such as oxygen or hydrogen, to the torch gas since dissociation products, such as atomic oxygen or atomic hydrogen, which are formed in the high-intensity are help to *increase the yields of acetylene*. (Anderson, col. 5, lines 30-35, emphasis added)

Applicants, therefore, respectfully request reconsideration and allowance of claims 1 through 3 and 5 through 7.

<u>Claims 8 through 10, 12 through 16 and 18</u>

Independent claim 8, as amended herein, is directed to a method for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles. The method comprises: introducing a stream of plasma arc gas between electrodes of a plasma torch including at least one pair of electrodes positioned adjacent to an inlet end of an axial reactor chamber, the stream of plasma arc gas being introduced at a selected plasma gas flow rate while the electrodes are subjected to a selected plasma input power level to produce a plasma in a restricted diameter injection line; *forming a gaseous stream by injecting at least one reactant into the injection line and thoroughly mixing the reactant into the plasma within the injection line and prior to entry thereof into a reactor chamber;* introducing the gaseous stream into a reactor chamber; *maintaining a volume defined by the reactor chamber at a substantially uniform temperature as the thoroughly mixed stream passes therethrough*; bringing the mixed reactant stream to an equilibrium state; cooling the gaseous stream including passing the gaseous stream through a nozzle at an outlet end of the reactor chamber; and separating the desired end product from gases remaining in the cooled gaseous stream. Applicant submits that Anderson fails to teach all of the limitations of claim 8 of the presently claimed invention.

The Examiner cites Anderson as disclosing an arc torch chemical reactor for the

production of acetylene from methane wherein a reactant stream is passed into the reactor and mixed with a heating gas. The Examiner further cites Anderson as teaching that the "temperature is maintained at 5000K, which is a uniform temperature over the length of the reaction zone" and that the reactor includes an insulating layer comprising carbon and zirconia. (Final Action, page 3).

The Examiner cites Davis as teaching a process of carrying out high temperature, chemical reactions, including reductions for producing elemental metal powders using a plasma generator. More specifically, the Examiner cites Davis as teaching that the stabilizer gas which is used to generate the plasma may also comprise a reactant gas; that the feed gas and the reactant gas are carried by the plasma into an axially extending reaction member; and that the plasma reactor may be maintained between a temperature range of 1800°K and 5000°K.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the teachings of Anderson based on the teachings of Davis by thoroughly mixing a reactant stream with a heating gas within an injection line stating that one of ordinary skill in the art "would have been motivated to combine the cited references, because Anderson and Davis et al., both teach processes for converting one or more reactants to a desired end product." (Final Action, page 4). Applicants respectfully traverse this rejection.

Applicants respectfully submit that neither Anderson nor Davis teach or suggest *forming a gaseous stream by injecting at least one reactant into the injection line and thoroughly mixing the reactant into the plasma within the injection line and prior to entry thereof into a reactor chamber.*

While the Examiner cites Anderson as teaching an arc torch reactor which maintain a substantially uniform temperature at 5000° K over the length of a reaction zone, Applicants note that Anderson actually states that the "*effective* temperature of the arc *effluent* in the examples [is] about 5000° K." (Col. 5, lines 40-42). Applicant notes that Anderson sets forth the temperature of the *effluent* (e.g., outflowing gas), not of the

volume defined by the reaction chamber. Additionally, the use of the adjective *effective* as a modifier for the term "temperature" clearly indicates variation in the effluent temperature. Applicant submits that Anderson fails to teach or suggest that a volume defined by the reactor chamber is maintained at a substantially uniform temperature as the thoroughly mixed stream passes therethrough.

Additionally, while the Examiner points to a teaching in Davis regarding the ability to introduce a reactant at any of a number of locations, such fails to teach or suggest *injecting at least one reactant into the injection line and thoroughly mixing the reactant into the plasma within the injection line and prior to entry thereof into a reactor chamber.* Moreover, as set forth above, Applicant submits that the Examiner has failed to provide adequate motivation to combine Anderson with Davis. As such, Applicants submit that claim 8 is clearly allowable over Anderson and Davis.

Applicants further submit that claims 9, 10, 12 through 16 and 18 are allowable as being dependent from an allowable base claim as well as for the additional patentable subject matter introduced thereby.

With respect to claim 10, Applicants submit that Anderson and Davis fail to teach or suggest that the reactant stream comprises methane or carbon monoxide and the desired end product comprises hydrogen. While the Examiner cites Anderson as teaching such subject matter, Applicants note that Anderson teaches the use of hydrogen as a torch gas, not as a desired end product. More specifically, Anderson states the following:

> In the *production of acetylene* from hydrocarbons, it has been found desirable to add dissociable gases, such as oxygen or hydrogen, to the torch gas since dissociation products, such as atomic oxygen or atomic hydrogen, which are formed in the high-intensity are help to *increase the yields of acetylene.* (Anderson, col. 5, lines 30-35, emphasis added)

Applicants, therefore, respectfully request reconsideration and allowance of claims 8 through 10 and 12 through 16 and 18.

Claims 33, 34, 36, 44 and 45

Independent claim 33 is directed to a method for thermally converting one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles. The method comprises: introducing a reactant stream into an axial reactor at an upstream end thereof; heating the reactant stream as the reactant stream flows axially through an injection line; passing the reactant stream axially through a volume defined by a reactor chamber of the axial reactor; *maintaining the volume defined by the reactor chamber at a substantially uniform temperature*; producing a stream containing the desired product stream at a location adjacent an outlet end of the reactor chamber; and cooling stream containing the desired end product exiting from the reactor chamber. Applicants submit that Anderson and Davis fail to teach or suggest all of the limitations of claim 33.

The Examiner cites Anderson as disclosing an arc torch chemical reactor for the production of acetylene from methane wherein a reactant stream is passed into the reactor and mixed with a heating gas. The Examiner further cites Anderson as teaching that the "temperature is maintained at 5000K, which is a uniform temperature over the length of the reaction zone" and that the reactor includes an insulating layer comprising carbon and zirconia. (Final Action, page 3).

The Examiner cites Davis as teaching a process of carrying out high temperature, chemical reactions, including reductions for producing elemental metal powders using a plasma generator. More specifically, the Examiner cites Davis as teaching that the stabilizer gas which is used to generate the plasma may also comprise a reactant gas; that the feed gas and the reactant gas are carried by the plasma into an axially extending reaction member; and that the plasma reactor may be maintained between a temperature range of 1800°K and 5000°K.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the teachings of Anderson based on the teachings of Davis by thoroughly mixing a reactant stream with a heating gas within an injection line stating that one of ordinary skill in the art "would have been motivated to combine the cited references, because Anderson and Davis et al., both teach processes for converting one or more reactants to a desired end product." (Final Action, page 4). Applicants respectfully traverse this rejection.

Applicants respectfully submit that neither Anderson nor Davis teach or suggest *maintaining the volume defined by the reactor chamber at a substantially uniform temperature*.

While the Examiner cites Anderson as teaching an arc torch reactor which maintain a substantially uniform temperature at 5000° K over the length of a reaction zone, Applicants note that Anderson actually states that the "*effective* temperature of the arc *effluent* in the examples [is] about 5000° K." (Col. 5, lines 40-42). Applicant notes that Anderson sets forth the temperature of the *effluent* (e.g., outflowing gas), not of the volume defined by the reaction chamber. Additionally, the use of the adjective *effective* as a modifier for the term "temperature" clearly indicates variation in the effluent temperature. Applicant submits that Anderson fails to teach or suggest that a volume defined by the reactor chamber is maintained at a substantially uniform temperature.

As such, Applicants submit that claim 33 is clearly allowable over Anderson and Davis. Applicants further submit that claims 34, 36, 44 and 45 are allowable at least by virtue of their dependency from an allowable base claim. Applicants, therefore, respectfully request reconsideration and allowance of claims 33, 34, 36, 44 and 45.

<u>Claims 46 and 50</u>

Independent claim 46, as amended herein, is directed to a method of forming a metal, metal oxide or metal alloy from a metal-containing compound. The method comprises: providing a plasma formed from a gas comprising an inert gas, hydrogen, or a

mixture thereof; providing a reagent or a reagent mixture, the reagent or reagent mixture comprising a gaseous or volatilized compound of a selected metal; *thoroughly mixing the reagent or reagent mixture with the plasma at a location upstream from an axial reactor chamber* to produce a reactant stream; passing the reactant stream axially through the reactor chamber; *maintaining the reactor chamber at a substantially uniform temperature*; producing a product stream at a location adjacent an outlet end of the reactor chamber, the product stream including an equilibrium mixture comprising the selected metal, metal oxide or metal alloy, wherein the selected metal, metal oxide or metal alloy being thermodynamically stable; cooling the product stream exiting the outlet end of the reactor chamber; and separating the metal, metal oxide or metal alloy from gases remaining in the cooled product stream.

The Examiner cites Anderson as disclosing an arc torch chemical reactor for the production of acetylene from methane wherein a reactant stream is passed into the reactor and mixed with a heating gas. The Examiner further cites Anderson as teaching that the "temperature is maintained at 5000K, which is a uniform temperature over the length of the reaction zone" and that the reactor includes an insulating layer comprising carbon and zirconia. (Final Action, page 3).

The Examiner cites Davis as teaching a process of carrying out high temperature, chemical reactions, including reductions for producing elemental metal powders using a plasma generator. More specifically, the Examiner cites Davis as teaching that the stabilizer gas which is used to generate the plasma may also comprise a reactant gas; that the feed gas and the reactant gas are carried by the plasma into an axially extending reaction member; and that the plasma reactor may be maintained between a temperature range of 1800°K and 5000°K.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the teachings of Anderson based on the teachings of Davis by thoroughly mixing a reactant stream with a heating gas within an injection line stating that one of ordinary skill in the art "would have been motivated to combine the cited

references, because Anderson and Davis et al., both teach processes for converting one or more reactants to a desired end product." (Final Action, page 4). Applicants respectfully traverse this rejection.

Applicants respectfully submit that neither Anderson nor Davis teach or suggest *maintaining the volume defined by the reactor chamber at a substantially uniform temperature.*

While the Examiner cites Anderson as teaching an arc torch reactor which maintain a substantially uniform temperature at 5000° K over the length of a reaction zone, Applicants note that Anderson actually states that the "*effective* temperature of the arc *effluent* in the examples [is] about 5000° K." (Col. 5, lines 40-42). Applicant notes that Anderson sets forth the temperature of the *effluent* (e.g., outflowing gas), not of the volume defined by the reaction chamber. Additionally, the use of the adjective *effective* as a modifier for the term "temperature" clearly indicates variation in the effluent temperature. Applicants submit that Anderson fails to teach or suggest that a volume defined by the reactor chamber is maintained at a substantially uniform temperature.

Applicants further submit that Anderson and Davis fail to teach or suggest thoroughly mixing a reagent or reagent mixture with the plasma at a location upstream from the reactor chamber.

While the Examiner points to a teaching in Davis regarding the ability to introduce a reactant at any of a number of locations, such fails to teach or suggest thoroughly mixing a reagent or reagent mixture with the plasma at a location upstream from the reactor chamber. Moreover, as set forth above, Applicant submits that the Examiner has failed to provide adequate motivation to combine Anderson with Davis. As such, Applicants submit that claim 46 is clearly allowable over Anderson and Davis.

Applicants further submit that claim 50 is allowable at least by virtue of their dependency from an allowable base claim. Applicants, therefore, respectfully request reconsideration and allowance of claims 46 and 50.

Claim 58 through 60

Independent claim 58, as amended herein, is directed to a method of forming a desired product from a hydrocarbon. The method comprises: providing a plasma formed from a gas comprising an inert gas, hydrogen, or a mixture thereof; providing a reagent or a reagent mixture, the reagent or reagent mixture comprising gaseous or volatilized hydrocarbon; *thoroughly mixing the reagent or reagent mixture with the plasma at a location upstream from a reactor chamber* to produce a reactant stream; passing the reactant stream axially through a volume defined by the reactor chamber; *maintaining the volume defined by the reactor chamber at a substantially uniform temperature*; forming a product stream including an equilibrium mixture comprising the desired product, the desired product being thermodynamically stable; cooling the product stream as it exits an outlet end of the reactor chamber; and separating the desired end product from gases remaining in the cooled product stream.

The Examiner cites Anderson as disclosing an arc torch chemical reactor for the production of acetylene from methane wherein a reactant stream is passed into the reactor and mixed with a heating gas. The Examiner further cites Anderson as teaching that the "temperature is maintained at 5000K, which is a uniform temperature over the length of the reaction zone" and that the reactor includes an insulating layer comprising carbon and zirconia. (Final Action, page 3).

The Examiner cites Davis as teaching a process of carrying out high temperature, chemical reactions, including reductions for producing elemental metal powders using a plasma generator. More specifically, the Examiner cites Davis as teaching that the stabilizer gas which is used to generate the plasma may also comprise a reactant gas; that the feed gas and the reactant gas are carried by the plasma into an axially extending reaction member; and that the plasma reactor may be maintained between a temperature range of 1800°K and 5000°K.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to modify the teachings of Anderson based on the teachings of Davis by

thoroughly mixing a reactant stream with a heating gas within an injection line stating that one of ordinary skill in the art "would have been motivated to combine the cited references, because Anderson and Davis et al., both teach processes for converting one or more reactants to a desired end product." (Final Action, page 4). Applicants respectfully traverse this rejection.

Applicants respectfully submit that neither Anderson nor Davis teach or suggest *maintaining the volume defined by the reactor chamber at a substantially uniform temperature*.

While the Examiner cites Anderson as teaching an arc torch reactor which maintain a substantially uniform temperature at 5000° K over the length of a reaction zone, Applicants note that Anderson actually states that the "*effective* temperature of the arc *effluent* in the examples [is] about 5000° K." (Col. 5, lines 40-42). Applicant notes that Anderson sets forth the temperature of the *effluent* (e.g., outflowing gas), not of the volume defined by the reaction chamber. Additionally, the use of the adjective *effective* as a modifier for the term "temperature" clearly indicates variation in the effluent temperature. Applicant submits that Anderson fails to teach or suggest that a volume defined by the reactor chamber is maintained at a substantially uniform temperature.

Applicants further submit that Anderson and Davis fail to teach or suggest thoroughly mixing a reagent or reagent mixture with the plasma at a location upstream from the reactor chamber.

While the Examiner points to a teaching in Davis regarding the ability to introduce a reactant at any of a number of locations, such fails to teach or suggest thoroughly mixing a reagent or reagent mixture with the plasma at a location upstream from the reactor chamber. Moreover, as set forth above, Applicants submit that the Examiner has failed to provide adequate motivation to combine Anderson with Davis. As such, Applicants submit that claim 46 is clearly allowable over Anderson and Davis.

Applicants further submit that that claims 59 and 60 are allowable at least by virtue of their dependency from an allowable base claim. Applicants, therefore,

respectfully request reconsideration and allowance of claims 58 through 60.

Obviousness Rejection Based on U.S. Patent No. 3,051,639 to Anderson in View of U.S. Patent No. 3,954,954 to Davis et al., and Further in View of U.S. Patent No. 4,335,080 to Davis et al., U.S. Patent No. 5,017,754 to Drouet et al., and U.S. Patent No. 3,429,691 to McLaughlin

Claims 4, 11, 35, 56, and 57 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anderson (U.S. Patent No. 3,051,639) in view of Davis et al. (U.S. Patent No. 3,954,954), as applied to claims 1 through 3, 5 through 10, 12 through 16, 18, 33, 34, 36, 44 through 46, 50, and 58 through 60 above, and further in view of Davis et al. (U.S. Patent No. 4,335,080), Drouet et al. (U.S. Patent No. 5,017,754), and McLaughlin (U.S. Patent No. 3,429,691). Applicants respectfully traverse this rejection, as hereinafter set forth.

Claim 4

Claim 4 depends from independent claim 1 and introduces the additional subject matter of the reactant stream comprising a titanium compound and the desired end product comprising titanium or titanium dioxide.

The Examiner relies on Anderson and Davis as applied to claims 1-3, 5-10, 12-16, 18, 33, 34, 44-46, 50 and 58-60 herein above. The Examiner then cites Davis '080 as teaching a plasma apparatus which may used for producing titanium dioxide; McLaughlin as teaching that titanium dioxide may be produced by using a mixture comprised of titanium tetrachloride and oxygen; and Drouet as teaching the use of a plasma reactor "for the benefication of titanium ores and in gas purification and arc starters." (Final Action, pages 5 and 6). The Examiner concludes that it would have been obvious to one of skill in the art to modify the teachings of Anderson with the teachings of Davis '080, McLaughlin, and Drouet to obtain the desired end product of the presently claimed invention. The Examiner states that such modification would have been obvious

"because on of ordinary skill in the art would expect a method for producing desired products from a plasma reactor as taught by Davis et al.['080], McLaughlin, and Drouet et al. to be similarly useful and applicable to the plasma process and apparatus for producing desired end product as taught by Anderson." (Final Action, page 6).

As discussed above, Applicants submit that Anderson and Davis fail to teach or suggest all of the limitations of claim 1 of the presently claimed invention. More particularly, Anderson and Davis fail to teach or suggest *independently introducing a stream of heating gas into the injection line for mixture with the reactant stream and thoroughly mixing the reactant stream with the heating gas within the injection line to produce a thoroughly mixed reactant stream prior to entry thereof into a reactor chamber.* Nor do Anderson and Davis teach or suggest *maintaining a volume defined by the reactor chamber at a substantially uniform temperature as the thoroughly mixed reactant stream passes therethrough.* Applicants submit that Davis '080, McLaughlin and Drouet also fail to teach or suggest such subject matter. As such, Applicants submit that claim 4 is allowable over the references relied upon by the Examiner at least by virtue of its dependency from an allowable base claim.

Applicants further submit that there is a lack of motivation to combine the references in the manner suggested by the Examiner. Particularly, Applicants submit that the Examiner's statement of motivation to combine the references is simply conclusory. It is noted that Anderson teaches the pyrolization of gases, such as the cracking of methane to produce acetylene. Applicants find no teaching or suggestion by Anderson that the apparatus and method set forth thereby is applicable to the harvesting of fine powders or particles such as, for example, is set forth in Davis or Davis '080. This is particularly evident in the fact that substantially different devices and processes are set forth by the various references relied upon by the Examiner as compared to that disclosed by Anderson. For example, Davis '080 discloses a device with a dual reaction chamber, Drouet et al. discloses a device wherein the feedstock is a powder, and McLaughlin discloses an apparatus which utilizes a counterflow technique.

Applicants submit that one of ordinary skill in the art would recognize that the processes taught by the references relied upon by the Examiner are highly specialized and individualized for specific production purposes. Further, Applicants submit that one of ordinary skill in the art would recognize that such devices would not be easily modified or altered without experiencing a likely deterioration in their respective performances.

Applicants, therefore, submit that claim 4 is allowable over the references relied upon by the Examiner and respectfully requests reconsideration and allowance thereof.

Claim 11

Claim 11 depends from independent claim 8 and introduces the additional subject matter of the reactant stream comprising a titanium compound and the desired end product comprising titanium or titanium dioxide.

The Examiner relies on Anderson and Davis as applied to claims 1-3, 5-10, 12-16, 18, 33, 34, 44-46, 50 and 58-60 herein above. The Examiner then cites Davis '080 as teaching a plasma apparatus which may used for producing titanium dioxide; McLaughlin as teaching that titanium dioxide may be produced by using a mixture comprised of titanium tetrachloride and oxygen; and Drouet as teaching the use of a plasma reactor "for the benefication of titanium ores and in gas purification and arc starters." (Final Action, pages 5 and 6). The Examiner concludes that it would have been obvious to one of skill in the art to modify the teachings of Anderson with the teachings of Davis '080, McLaughlin, and Drouet to obtain the desired end product of the presently claimed invention. The Examiner states that such modification would have been obvious "because on of ordinary skill in the art would expect a method for producing desired products from a plasma reactor as taught by Davis et al.['080], McLaughlin, and Drouet et al. to be similarly useful and applicable to the plasma process and apparatus for producing desired end product as taught by Anderson." (Final Action, page 6).

As discussed above, Applicants submit that Anderson and Davis fail to teach or suggest all of the limitations of claim 8 of the presently claimed invention. More

particularly, Anderson and Davis fail to teach or suggest *forming a gaseous stream by injecting at least one reactant into the injection line and thoroughly mixing the reactant into the plasma within the injection line and prior to entry thereof into a reactor chamber*, or *maintaining a volume defined by the reactor chamber at a substantially uniform temperature as the thoroughly mixed stream passes therethrough.* Applicants submit that Davis '080, McLaughlin and Drouet also fail to teach or suggest such subject matter. Applicants further submit that there is a lack of motivation to combine the references in the manner suggested by the Examiner as previously discussed.

As such, Applicants submit that claim 11 is allowable over the references relied upon by the Examiner at least by virtue of its dependency from an allowable base claim and respectfully request reconsideration and allowance thereof.

Claim 35

Claim 35 depends from claim 33 and introduces the additional subject matter of providing at least one reactant selected from the group consisting of titanium tetrachloride, vanadium tetrachloride, aluminum trichloride and natural gas.

The Examiner relies on Anderson and Davis as applied to claims 1-3, 5-10, 12-16, 18, 33, 34, 44-46, 50 and 58-60 herein above. The Examiner then cites Davis '080 as teaching a plasma apparatus which may used for producing titanium dioxide; McLaughlin as teaching that titanium dioxide may be produced by using a mixture comprised of titanium tetrachloride and oxygen; and Drouet as teaching the use of a plasma reactor "for the benefication of titanium ores and in gas purification and arc starters." (Final Action, pages 5 and 6). The Examiner concludes that it would have been obvious to one of skill in the art to modify the teachings of Anderson with the teachings of Davis '080, McLaughlin, and Drouet to obtain the desired end product of the presently claimed invention. The Examiner states that such modification would have been obvious "because one of ordinary skill in the art would expect a method for producing desired products from a plasma reactor as taught by Davis et al.['080], McLaughlin, and Drouet

et al. to be similarly useful and applicable to the plasma process and apparatus for producing desired end product as taught by Anderson." (Office Action, pages 4 and 5).

As discussed above, Applicants submit that Anderson and Davis fail to teach or suggest all of the limitations of claim 33 of the presently claimed invention. More particularly, Anderson and Davis fail to teach or suggest *maintaining the volume defined by the reactor chamber at a substantially uniform temperature*. Applicants submit that Davis '080, McLaughlin and Drouet also fail to teach or suggest such subject matter. Applicants further submit that there is a lack of motivation to combine the references in the manner suggested by the Examiner as previously discussed.

As such, Applicants submit that claim 35 is allowable over the references relied upon by the Examiner at least by virtue of its dependency from an allowable base claim and respectfully request reconsideration and allowance thereof.

Claim 56 and 57

Claims 56 and 57 depend from independent claim 46. Claim 56 introduces the additional subject matter of forming a metal oxide of the selected metal, wherein the reagent or reagent mixture further comprises oxygen. Claim 57 introduces the subject matter of forming titanium dioxide, wherein the reagent or reagent mixture comprises titanium tetrachloride and oxygen.

The Examiner relies on Anderson and Davis as applied to claims 1-3, 5-10, 12-16, 18, 33, 34, 44-46, 50 and 58-60 herein above. The Examiner then cites Davis '080 as teaching a plasma apparatus which may used for producing titanium dioxide; McLaughlin as teaching that titanium dioxide may be produced by using a mixture comprised of titanium tetrachloride and oxygen; and Drouet as teaching the use of a plasma reactor "for the benefication of titanium ores and in gas purification and arc starters." (Final Action, pages 5 and 6). The Examiner concludes that it would have been obvious to one of skill in the art to modify the teachings of Anderson with the teachings of Davis '080, McLaughlin, and Drouet to obtain the desired end product of the presently claimed

invention. The Examiner states that such modification would have been obvious "because on of ordinary skill in the art would expect a method for producing desired products from a plasma reactor as taught by Davis et al.['080], McLaughlin, and Drouet et al. to be similarly useful and applicable to the plasma process and apparatus for producing desired end product as taught by Anderson." (Office Action, pages 4 and 5).

As discussed above, Applicants submit that Anderson and Davis fail to teach or suggest all of the limitations of claim 46 of the presently claimed invention. More particularly, Anderson and Davis fail to teach or suggest *thoroughly mixing the reagent or reagent mixture with the plasma at a location upstream from an axial reactor chamber* or *maintaining the reactor chamber at a substantially uniform temperature*. Applicants submit that Davis '080, McLaughlin and Drouet also fail to teach or suggest such subject matter. Applicants further submit that there is a lack of motivation to combine the references in the manner suggested by the Examiner as previously discussed.

As such, Applicants submit that claims 56 and 57 are allowable over the references relied upon by the Examiner at least by virtue of their dependency from an allowable base claim and respectfully request reconsideration and allowance thereof.

<u>Obviousness Rejection Based on U.S. Patent No. 3,051,639 to Anderson in View of U.S. Patent No. 3,954,954 to Davis et al., and Further in View of McFeaters et al. ("Application of Nonequilibrium Gas-Dynamic Techniques to the Plasma Synthesis of Ceramic Powders")</u>

Claims 17, 37, 39, 40, 42, and 43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anderson (U.S. Patent No. 3,051,639) in view of Davis et al. (U.S. Patent No. 3,954,954), as applied to claims 1 through 3, 5 through 10, 12 through 16, 18, 33, 34, 36, 44 through 46, 50, and 58 through 60 above, and further in view of McFeaters et al. ("Application of Nonequilibrium Gas-Dynamic Techniques to the Plasma Synthesis of Ceramic Powders"). Applicants respectfully traverse this rejection, as hereinafter set forth.

Claim 17

Claim 17 depends from independent claim 8 by way of intervening claim 12 and introduces the additional subject matter of passing the gaseous stream through a coaxial convergent-divergent nozzle positioned in the outlet end of the reactor chamber. The Examiner relies on the combination of Anderson and Davis as applied to claims 1-3, 5-10, 12-16, 18, 33, 34, 44-46, 50 and 58-60 herein above. The Examiner further cites McFeaters as disclosing the use of a converging-diverging nozzle to achieve high cooling rates.

As discussed hereinabove, the combination of Anderson and Davis fail to teach or suggest all of the limitations of independent claim 8. More particularly, this combination of references fails to teach or suggest *forming a gaseous stream by injecting at least one reactant into the injection line and thoroughly mixing the reactant into the plasma within the injection line and prior to entry thereof into a reactor chamber*, or *maintaining a volume defined by the reactor chamber at a substantially uniform temperature as the thoroughly mixed stream passes therethrough.* Applicants submit that McFeaters likewise fails to teach or suggest such subject matter. Moreover, as set forth above, Applicants submit that there is a lack of motivation for combining the references in the manner suggested by the Examiner and that Examiner's statement of motivation is merely conclusory.

Applicants, therefore, submit that claim 17 is allowable over Anderson, Davis, and McFeaters and respectfully requests reconsideration and allowance thereof.

Claims 37, 39, 40, 42 and 43

Claims 37, 39, 40, 42 and 43 all depend from independent claim 33 either directly or by way of an intervening claim. The Examiner relies on the combination of Anderson and Davis ('080) as applied to claims 1-3, 5-10, 12-16, 18, 33, 34, 44-46, 50 and 58-60 herein above. The Examiner further cites McFeaters as disclosing the use of a

converging-diverging nozzle to achieve high cooling rates.

As discussed above herein, the combination of Anderson and Davis fails to teach or suggest all of the limitations of independent claim 33. More particularly, this combination of references fails to teach or suggest maintaining a volume defined by the reactor chamber at a substantially uniform temperature. Applicants submit that McFeaters likewise fails to teach or suggest such subject matter. Moreover, as set forth above, Applicants submit that there is a lack of motivation for combining the references in the manner suggested by the Examiner and that Examiner's statement of motivation is merely conclusory.

Additionally, with respect to claim 39, Applicants submit that McFeaters fails to teach or suggest passing the stream containing the desired end product through a converging-diverging nozzle wherein the diverging section of the nozzle exhibits an included angle of less than about 35°.

Applicants, therefore, submit that claim 37, 39, 40, 42 and 43 are allowable over Anderson, Davis and McFeaters and respectfully requests reconsideration and allowance thereof.

ENTRY OF AMENDMENTS

The amendments to claims 1 and 8 above should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add any new matter to the application.

CONCLUSION

Claims through 18, 33 through 37, 39, 40, 42 through 46, 50, and 56 through 60 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, he is respectfully invited to contact Applicants' undersigned attorney.

Respectfully submitted,

Stephen R. Christian
Registration No. 32,687
Attorney for Applicants
P.O. Box 1625
Idaho Falls, Idaho 83415-3899.
(208) 526-9140
(208) 526-8339 FAX

Date: 26 FEB 2004